

Valve seat locking by a latch pin

Field of the invention:

5 The present invention concerns a coupling valve for connecting two fluid conduits for transfer of fluids between two loading/offloading units, for example between a marine vessel and a marine installation or from a carrier vessel to a production vessel or vice versa. The invention is in particular related to a coupling valve suitable for transfer of fluids such as liquid carbon dioxide and liquid natural gases.

Background and prior art

10 When connecting a first fluid conduit from a vessel or installation to a second fluid conduit from another vessel or installation, a coupling valve system comprising a first and second coupling housing, connected to said first and second fluid conduit respectively, is commonly used. Before a secure coupling of the first and second fluid conduit is achieved, the first and second coupling housings is typically kept in a sealed state to prevent any leak of fluids from the fluid conduits.

15 Such couplings may be called dry break couplings and are known in the art.

WO8803243 A1 discloses a coupling for connecting fluid conduits, comprising an insert nipple and receiving nipple. Said nipples being axially moveable in relation to each other for connection and disconnection. The insert nipple comprises a stationary sleeve with a sealing valve body that is spring-biased and inwardly axially movable therein. Said receiving nipple having an outer sleeve, an inner spring-biased and inwardly axially movable sealing sleeve and a stationary valve central stay which in disconnected condition sealingly cooperates with the sealing sleeve. The coupling also displays a centrally placed eliminator plunger for passing evacuated spill from one coupling part to the other.

25 US4271865A discloses a dry break coupling which comprises a first and second housing adapted for coded connection to one another. The purpose is to prevent accidental coupling to a storage tank meant for a different fluid than is loaded. Also disclosed is a mechanism to prevent opening of a piston and poppet valve in the housing when the housings are not connected. The mechanism includes a stop pin supported in a radially extended socket in an interlock ring. The piston has a peripheral opening for registration with the socket for receiving the stop fin when the piston is in a closed position. The poppet has an identical system with a second stop pin and a second socket for engagement with a peripheral opening. The stop pins are slidably moved as a response to a pivotable movement when coding pins are engaged with an interlock rim and pivoted to couple the first and second housing together. The described coupling is adapted for manual operation of the coupling and requires pivotal movement.

During the coupling procedure of fluid conduits between loading/offloading units at sea or in a maritime environment, at least one coupling housing connected to a fluid conduit is commonly exposed to the sea and also submerged in the sea.

5 If a common pressure sensitive valve is used in a coupling housing exposed or submerged in the sea, there is a risk that the pressure exerted by the water column may be large enough to trigger and open the valve. This could result in unwanted release of fluid from the fluid conduit causing loss of product and possibly pollution. If the fluid is in a state of very low temperature such as is the case for liquid carbon dioxide and liquid natural gases, formation of ice may also take place
10 on the fluid conduit, coupling and valve making coupling difficult or even impossible.

Thus, there is a need for a secure valve to remedy the above mentioned draw-backs and which does not open when merely submerged in water.

15 It is thus an object of the present invention to provide a coupling housing for a fluid conduit with a valve that allows for reliable coupling and minimizes or eliminates the risk of accidental opening of the valve.

Another object of the present invention is to provide a coupling system that facilitates a secure coupling of two fluid conduits and minimizes the risk of accidental leakage.

20 Yet another object of the present invention is to provide a method for connecting two fluid conduits while minimizing the risk of leakage from the fluid conduits.

Summary of the invention:

The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention.

25 In a first aspect, the invention concerns a coupling housing suitable for sealingly coupling fluid conduits wherein the coupling housing is configured in a first axial end for fluid connection to a fluid conduit, the coupling housing comprising a second axial end opposite of the first axial end, a central longitudinal axis B, defining an axial direction z from the first axial end to the second axial end, a radial
30 direction r and a circumferential direction c, a coupling flange extending in the radial direction r and arranged at the second axial end, the coupling flange comprising an opening for flow of fluid therethrough, the coupling housing may comprise a valve assembly comprising a valve disc configured to be axially movable relative to the coupling housing and comprising a valve disc surface facing
35 substantially in or in the same direction as the coupler flange, wherein the valve assembly is connected to the coupling housing and configured to switch between a

closed position, wherein the valve disc is configured to sealably cover the opening, and an open position wherein the valve disc is removed from the opening for allowing flow of fluid therethrough, wherein the valve assembly further comprises

- 5 - a push pin arranged for protruding through the valve disc surface, wherein the push pin is configured to be axially movable relative to the valve disc,
- a locking mechanism connected to and activated by the push pin,

wherein the locking mechanism is configured to switch between

- 10 - a locked position for locking the valve assembly in the closed position, wherein the push pin in a first position protrudes through the valve disc surface and
- an unlocked position, wherein the push pin in a second position have been moved axially towards the valve disc for allowing the valve assembly to switch to the open position.

- 15 The coupling housing is in one example suitable for sealingly coupling to a second coupling housing attached to a fluid conduit.

As used herein the term “fluid” is understood to cover a gas or a liquid.

- 20 The locking mechanism may further comprise at least one locking bar, arranged for connection to the push pin, wherein the at least one locking bar is configured for engaging with the coupling housing when the locking mechanism is in the locked position, and wherein the at least one locking bar is configured for being retracted from the coupling housing when the locking mechanism is in the unlocked position. The locking mechanism may comprise 1, 2, 3, 4, 5, 6, 7, 8 or more locking bars. The locking bars is for locking the valve assembly in the closed position. It is
- 25 understood that all locking bars must be retracted in order for the locking mechanism to be in the unlocked position.

- 30 The coupling housing may comprise a coupling housing groove arranged internally in the coupling housing and extending at least a part of the circumferential extent of the coupling housing, wherein the at least one locking bar is configured for
- extending into the coupling housing groove when the locking mechanism is in the locked position, and wherein the at least one locking bar is configured for being retracted from the second coupling housing groove when the locking mechanism is in the unlocked position. The coupling housing groove may be divided into several
- 35 sections in the circumferential direction or it may extend the entire circumferential extent of the coupling housing internally. The coupling housing groove may be located internally at the coupling flange.

The locking mechanism may comprise a rotation activator comprising at least one rotation activator tooth, fixed proximal to a first axial end of the push pin, a

rotational ring arranged coaxially and rotatably around the push pin, the rotational ring comprising at least one rotational ring recess adapted for receiving the at least one rotation activator tooth, a central longitudinal axis C, defining an axial direction z from the axial end distal from the first end of the push pin to the first end of the push pin, a radial direction r and a circumferential direction c, wherein the at least one locking bar is connected radially to the rotational ring, wherein the at least one rotation activator tooth is arranged at an angle α that is inclined compared to the central longitudinal axis C and configured to interact with the at least one rotational ring recess when the push pin is moved in an axial direction for initiating radial movement of the at least one locking bar. It could be envisaged that the rotation activator comprises more than one activator tooth, for example 2, 3, 4, 5, 6, 7, 8 or more. The locking mechanism translates an axial movement of the push pin into radial movement of the locking bars.

The valve assembly may comprise a valve assembly housing for accommodating the valve disc and the locking mechanism therein, where the valve assembly housing comprises valve assembly housing slots and the at least one locking bar is aligned with the valve assembly housing slots such that the at least one locking bar may enter therethrough and into the coupling housing groove. The valve assembly housing may protect and encase the locking mechanism. The valve assembly may comprise 2, 3, 4, 5, 6, 7, 8 or more locking bars.

The valve assembly may also comprise a valve assembly casing for slidably accepting at least a part of the valve assembly housing therein.

The valve assembly casing may also comprise a top edge facing in the axial direction z configured for abutting against the side of the valve disc facing opposite of the axial direction z for limiting the axial travel of the valve disc.

The coupling housing may comprise a push pin rotation stopper fixed to the push pin, and a rotation stopper fixed to the valve assembly casing wherein the push pin rotation lock protrudes radially from the push pin, extends in the axial direction and is arranged for interaction with the rotation stopper for limiting or eliminating the rotation of the push pin in the circumferential direction. This helps rotational force being transferred from the push pin to the rotational ring.

The valve assembly may comprise a force means connected to the coupling housing and configured for biasing the valve assembly towards the closed position. The force means may for example be a spring that exerts a force on the valve disc pushing the valve disc in the axial direction z such that the valve disc covers the opening if no other force is applied. The force means will thus bias the valve assembly towards the closed position.

The force means may be configured to abut against a valve spring bracket arranged distal from the valve disc, the valve spring bracket connected to the coupling housing and to abut against or be fixed to a valve rod bracket at the other end. The force means may for example be a spring.

- 5 The locking mechanism may comprise a secondary force means for biasing the push pin towards the first position. The secondary force means may for example be a spring.

10 The coupling housing may comprise valve assembly support fixed to the coupling housing, and wherein the valve assembly can be or is fixed to the valve assembly support. The valve assembly may be fixed to the valve assembly support via the valve assembly casing.

15 The invention may concern a coupling system for sealingly coupling fluid conduits comprising a coupling housing as described above and
a second coupling housing configured at a first axial end for fluid connection to a second fluid conduit, the second coupling housing comprising a second axial end
20 opposite of the first axial end, a central longitudinal axis A, defining an axial direction z from the second axial end to the first axial end, a radial direction r and a circumferential direction c, a second coupling flange extending in the radial direction r and arranged at the second axial end, the second coupling flange comprising an opening for flow of fluid therethrough, a second valve assembly comprising
a second valve disc configured to be axially movable relative to the second coupling housing and comprising a second valve disc surface facing substantially in the same direction as the second coupling flange,
25 wherein the second valve assembly is connected to the second coupling housing and configured to switch between
- a closed position wherein the second valve disc is configured to sealably cover the second opening and
- an open position, wherein the second valve disc has been removed from the
30 second opening for allowing flow of fluid therethrough,
wherein the second valve disc surface is configured for contacting and moving the push pin from the first position to the second position, and
wherein the second valve disc surface is further configured for contacting the valve disc surface and for moving axially into the coupling housing and thereby switching
35 the second valve assembly and the coupling house assembly between the respective closed and the open positions for allowing fluid to flow therethrough.

It is understood that the first coupling housing of the coupling system may comprise any one of the features disclosed above.

The second coupling housing may comprise at least one guide pin extending axially from the second coupling flange configured for contacting coupling flange for aligning the central longitudinal axis A with central longitudinal axis B.

5 The second valve assembly may comprise a valve actuator configured for moving the second valve disc axially.

The valve actuator may comprise a hydraulic inlet, and a hydraulic outlet for applying a hydraulic pressure to the second valve disc for actuating axial movement.

10 The hydraulic inlet, and the hydraulic outlet may be integrated in a second valve assembly support.

The second valve assembly support may be fixed to the second coupling housing, and the second valve assembly may be fixed to the second valve assembly support.

15 The coupling housing may comprise a coupling gripper interface, and the second coupling housing may comprise a coupling gripper configured for engaging with the coupling gripper interface.

The valve assembly may further comprises a valve disc sealing located between the valve disc and the coupling housing valve seat.

20 The invention also concerns a method for sealingly coupling fluid conduits, the method comprising the steps of

- providing the coupling system comprising the coupling housing and the second coupling housing as described above
- moving the coupling housing and the second coupling housing in proximity of each other,
- 25 - aligning the central longitudinal axis A with the central longitudinal axis B,
- achieving contact between the second valve disc surface and the push pin
- axially moving the coupling housing towards the second valve disc for pushing the push pin from the first position to the second position and thereby switching the locking mechanism from the locked position to the unlocked position, and
- 30 - achieving contact between the second valve disc surface and the valve disc surface,
- axially moving the second valve disc towards the coupling housing for pushing the second valve disc and the valve disc into the coupling housing and thereby switching the valve assembly and second valve assembly from the closed position
- 35 to the open position and establishing a fluid connection between the fluid conduits.

The method may further comprise the following

- providing the coupling system including the guiding pin,

- aligning the central longitudinal axis A with the central longitudinal axis B, by allowing the at least one guide pin to contact the coupling flange.

The method may further comprise the following

- 5 - providing the coupling housing comprising a coupling gripper interface, and the second coupling housing comprising a coupling gripper configured for engaging with the coupling gripper interface,
- 10 - coupling the second coupling housing and the first coupling housing by activating the coupling gripper for engaging the coupling gripper interface such that the second coupling housing and the first coupling housing are pulled together with a force sufficient to create a sealing pressure between the second coupling flange and the coupling flange.

Brief description of the drawings:

Fig. 1 shows the coupling housing where the valve assembly is in closed position and the locking mechanism is in the locked position.

- 15 Fig. 2 shows the coupling housing where the valve assembly is in a closed position and the locking mechanism is in the unlocked position.

Fig. 3 shows the coupling housing where the valve assembly is in an open position and the locking mechanism is in the unlocked position.

- 20 Fig. 4A shows a top view of the locking mechanism in the locked position with locking bars extended. The valve disc is not shown.

Fig 4B shows a perspective view of the valve assembly in the locked position with locking bars extended.

Fig. 5A shows a top view of the coupling valve assembly in the unlocked position with locking bars retracted and without the valve disc.

- 25 Fig. 5B shows a perspective view of the valve assembly in the unlocked position with locking bars retracted.

Fig. 6 shows a side view of selected internals of the valve assembly.

Fig. 7A and 7B shows an embodiment of the second valve assembly support.

- 30 Fig. 8 shows a side view of the first and second coupling housings while they are not connected.

Fig. 9 shows a side view of the coupling system with the coupling housings while they are in close proximity.

Fig. 10 shows a side view of the coupling system with the coupling housings while they are connected with a coupling gripper the coupling valve assemblies are in a closed position.

5 Fig. 11 shows a side view of the coupling system with the coupling housings while they are connected via a coupling gripper and the coupling valve assemblies are in an open position allowing fluid to flow through the coupling system.

Detailed description of the invention:

10 In the following, specific embodiments of the invention will be described in more detail with reference to the drawings. However, the invention is not limited to the embodiments and illustrations contained herein. It is specifically intended that the invention includes modified forms of the embodiments, including portions of the
15 embodiments and combinations of elements of different embodiments. It should be appreciated that in the development of any actual implementation, as in any engineering or design project, specific decisions must be made to achieve the developer's specific goals, such as compliance with system and/or business-related constraints. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication and manufacture for the skilled person having the benefit of this disclosure.

20 Fig. 1 shows a coupling housing 200 comprising a valve assembly 220 in a closed position and a locking mechanism 250 in the locked position. The coupling housing 200 is shown connected to a fluid conduit 201 at a first axial end 203 at a fluid conduit connection 202. The coupling housing 200 is open at the first axial end 203. The fluid conduit connection 202 may be any suitable connection known to the
25 person skilled in the art. One preferred fluid conduit connection 202 is a swivel connection that allows the coupling housing 200 to rotate freely relative to the fluid conduit 201 at the fluid conduit connection 202.

The coupling housing 200 further comprises a second axial end 204 located opposite the first axial end 203. The second axial end 204 is configured with a
30 coupling flange 205 extending radially from the coupling housing 200 at the second axial end 204 and is suitable for coupling to another coupling flange for providing a sealing coupling. The coupling flange 205 displays an opening 212 for flow of fluid therethrough. The coupling housing may comprise a coupling gripper interface 207 arranged on a side of the coupling flange 205 facing opposite of the axial direction
35 z.

As can be seen in Fig. 1 the coupling housing 200 comprises a central longitudinal axis B_x running centrally through the coupling housing 200 in the axial direction from the first axial end 203 to the second axial end 204 and defining an axial

direction z from the first axial end 203 to the second axial end 204, a radial direction r relative to the axial direction z and a circumferential direction c relative to the axial direction z .

5 The coupling housing 200 further comprises a valve assembly 220 with a valve disc 224 that is configured for sealingly closing the opening 212 by sealingly interacting with a coupling housing valve seat 206 located internally in the coupling housing 200, preferably located internally in the coupling flange 205. The valve disc 224 comprises a valve disc surface 224a facing in the axial direction z . The valve disc surface 224a is suitable for contacting another surface for example a surface on an external object such as another valve disc.

15 The valve disc 224 is configured to be axially movable along the central longitudinal axis B_x within the coupling housing 200 in order to switch between a closed position, wherein the valve disc 224 sealingly closes the opening 212, and an open position wherein the valve disc 224 is not covering the opening 212, and thereby allows for fluid to flow through the opening 212. The open position is illustrated in Fig. 3 and Fig. 11 and will be disclosed below.

Fig. 1 further illustrates that the valve assembly 220 may further comprises a valve disc sealing 223 located between the valve disc 224 and the coupling housing valve seat 206.

20 The valve disc 224 may be connected to a valve rod 227 which may extend axially and internally in the coupling housing 200. The valve rod 227 may extend in the axial direction z .

25 The coupling housing 200 further comprises a push pin 221 which may protrude through the valve disc surface 224a in the axial direction z . The push pin 221 is axially movable relative to the valve disc 224 and may be an integral part of the valve rod 227, or the push pin 221 may be connected to the valve rod 227 directly or indirectly. The function of the push pin 221 will be described in more detail below.

30 The coupling housing 200 further comprises a locking mechanism 250 which is configured to switch between a locked position and an unlocked position.

35 The locking mechanism may comprise at least one locking bar 251 which is configured to interact with the coupling housing 200 when the locking mechanism 250 is in the locked position. The locking mechanism 250 may also comprise between 2-4, or more locking bars 251. The unlocked position of the locking mechanism 250 is illustrated in Fig. 2, 3, 5A, 5B, 10 and 11 and will be disclosed in more detail below.

As shown in Fig. 1 the coupling housing 200 may comprise a coupling housing groove 213 located internally in the coupling flange 205. The coupling housing groove 213 extends at least a part of the circumferential extent of the inner side of the coupling flange 205, i.e. in the circumferential direction c of the inner side of the coupling flange 205. The coupling housing groove 213 may be continuous or divided into sections and configured for interaction with the locking bar 251 when the locking mechanism 250 is in the locked position, ie the coupling housing groove 213 is aligned in the axial direction z with the locking bar 251 when the locking mechanism 250 is in the locked position.. The coupling housing groove 213 is sufficiently deep for secure interaction with the locking bar 251.

The push pin 221 is further connected to and configured to activate the locking mechanism 250 by translating axial movement of the push pin 221 to radial movement of the locking bar 251. This translation of movement is disclosed in more detail below with reference to Fig. 4A, 4B, 5A, 5B and in particular Fig. 6.

As shown in Fig 1. the push pin 221 protrudes through the valve disc surface 224a in the axial direction z, the locking mechanism 250 is in the locked position where the locking bars 251 is engaging the coupling housing 200 via the coupling housing groove 213. In this locked position the valve assembly 220 is locked in the closed position resilient to an external force affecting the valve disc surface 224a in a direction opposite the axial direction z, such as hydrostatic pressure that could affect the coupling housing (200) in case of it being submerged in the sea.

Also shown in Fig. 1 is that the valve assembly 220 comprises a valve force means 226 which is suitable for applying a force in the axial direction z. The valve force means 226 may be a spring arranged coaxially around the valve rod 227 and connected to a valve force means bracket 234. The valve spring bracket 234 is attached to and may be located inside the coupling housing 200. The valve spring bracket 234 is arranged at the valve force means 226 end distal from the valve disc 224. The valve assembly may further comprise a valve rod force means bracket 235 fixed to the valve rod 227 at the valve force means 226 end proximal to the valve disc 224. The force means 226 is configured to abut against the valve force means bracket 234 at one end and to abut against the valve rod force means bracket 235 at the other end. The valve rod force means bracket 235 is connected to the valve disc 224. The valve force means 226 thereby exerts a force on the valve disc 224 in the axial direction z which is a force suitable for biasing the second valve assembly 220 towards the closed position.

The valve assembly 220 may comprise a valve assembly housing 240 for accommodating the valve disc 224 and the locking mechanism 250 therein.

The coupling housing 200 may further comprise a valve assembly casing 233 attached to the inside of the coupling housing 200 via a valve assembly support 209

shown in Figs. 7A, 7B. The valve assembly casing 233 is adapted for slidingly accepting at least a part of the valve assembly housing 240 therein. The valve assembly casing 233 encases the valve rod 227 and the valve force means 226. The valve force means bracket 234 may be attached to the valve assembly casing 233.

- 5 The valve rod 227 may extend through the valve assembly casing 233 at the end distal from the valve disc 224 for allowing axial movement of the valve rod 227 relative to the valve assembly casing 233.

Fig. 1 also shows a secondary force means 256. The secondary force means 256 may be a spring and may be connected to the push pin 221 at one end and abut
10 against the valve rod spring bracket 235 at the other end. The secondary force means 256 is configured to exert a force on the push pin 221 and the valve rod force means bracket 235 such that the force needed for pushing the push pin 221 from the first position where it protrudes through the valve disc surface 224a to the second position, where the push pin 221 has been moved axially towards the valve disc 224
15 is smaller than the force needed to push the valve disc 224 into the coupling housing 200.

The secondary force means 256 is also configured for exerting a force on the push pin 221 for biasing it towards the first position where the push pin 221 protrudes out from the valve disc surface 224a and the locking mechanism 250 is in the locked
20 position.

Now turning to Fig. 2 where coupling housing 200 is shown with the valve assembly 220 in the closed position and the locking mechanism 250 in the unlocked position where the push pin 221 is in the second position, pushed into the valve disc 224. The locking bars 251 are retracted from the coupling housing groove 213 and
25 thus not interacting with the coupling housing 200. In this configuration the locking mechanism 250 is in the unlocked position. The valve assembly 220 is in the closed position where the valve disc 224 sealingly covers the opening 212 but is free to move axially into the coupling housing 200 if sufficient force is applied to the valve disc 224 in the direction opposite of the axial direction z to overcome the force of
30 the valve force means 226.

The secondary force means 256 has extended and the valve rod force means bracket 235 has moved in the direction opposite of the axial direction z. An initial partial compression of the valve force means 226 may have taken place.

The valve assembly casing 233 may comprise an assembly casing top edge 233a facing in the axial direction z and towards the valve disc 224. The assembly casing top edge 233a is configured to limit the travel of the valve disc 224 which will abut
35 against the assembly casing top edge 233a when full travel of the valve disc 224 into the coupling housing is achieved.

Fig. 3 shows the coupling housing 200 with the valve assembly 220 in the open position where the valve disc 224 is not covering the opening 212. Liquid is thus allowed to flow through the opening 212. Note that the push pin 221 is in the second position and the locking mechanism 250 is in the unlocked position. The valve force means 226 has been compressed by a force acting on the valve disc surface 224a in the opposite direction of the axial direction z.

Fig. 3 shows that the valve disc 224 abuts against the assembly casing top edge 233a when maximum travel has been reached. The valve rod 227 is protruding through the bottom of the valve assembly casing 233.

If no force is acting on the valve disc surface 224a and the push pin 221 the valve assembly 220 will return to the closed position and the locking mechanism 250 will return to the locked position as shown in Fig. 1.

Fig. 4A and 4B shows the locking mechanism 250 in the locked position. Fig. 4 A shows a top view of the locking mechanism 250 where the valve disc 224 is removed for better visibility of the locking mechanism 250 internals. The locking mechanism 250 comprises a rotation activator 253 which is fixed to the push pin 221. The rotation activator is further configured to engage with a rotational ring 252. The locking bars 251 are connected radially to the rotational ring 252.

Fig. 4B shows the locking mechanism 250 and the valve disc 224 in the valve assembly housing 240. The valve assembly housing 240 comprises valve assembly housing slots 241 which is aligned with the locking bars 251 such that they may protrude therethrough when the locking mechanism 250 is in the locked position.

Figs. 5A and 5B show the locking mechanism 250 in the locked position. Note that the locking bars 251 have retracted from the valve assembly housing slots 241.

Fig. 6 shows selected internals of the locking mechanism 250. The rotation activator 253 is fixed proximal to a first end of the push pin 221. Fig. 6 shows a central longitudinal axis C_x , defining an axial direction z from the axial end distal from the first end of the push pin 221 to the first end of the push pin 221. The rotation activator 253 displays rotation activator teeth 254 that are arranged inclined at an angle α relative to the axial longitudinal axis C_x . The rotational ring 252 comprises rotational ring recesses 255 that are adapted for receiving the rotation activator teeth 254.

Also shown is a push pin rotation stopper 231 fixed to the push pin 221 proximal to the second end of said push pin 221. The push pin rotation stopper 231 protrudes radially, extends in the axial direction z from the push pin 221 and is arranged for interaction with a rotation stopper 211, which is fixed to the valve assembly casing 233. The interaction between the push pin rotation stopper 231 and rotation stopper

211 has the effect that rotation of the push pin 221 relative to the valve assembly casing 233 is kept to a minimum or eliminated.

From the arrangement shown in Fig. 6 it is understood that an axial movement of the push pin 221 between the first and second position causes engagement of the rotation activator teeth 254 with the rotational ring recesses 255 which due to the inclination of the rotation activator teeth 254 translates the axial movement of the push pin 221 into circumferential movement of the rotational ring 252 and then to radial movement of the locking bars 251. This translation of axial movement of the push pin 221 into radial movement of the locking bars 251 enables switching the locking mechanism 250 from the locked position to the unlocked position and vice versa.

Fig. 7A and 7B shows the valve assembly support 209 which may be attached to the coupling housing 200 (not shown) and to which the valve assembly casing 233 may be fixed.

Fig 8 shows a coupling system 10 comprising the coupling housing 200 as disclosed above and a second coupling housing 100. The second coupling housing 100 comprises a valve assembly 120 shown in a closed position. The second coupling housing 100 is shown connected to a second fluid conduit 101 at a first axial end at a second fluid conduit connection 107. The second coupling housing 100 is open at the first axial end. The second fluid conduit connection 107 may be any suitable connection known to the person skilled in the art. One type of second fluid conduit connection 107 is a swivel connection that allows the second coupling housing 100 to rotate freely relative to the second fluid conduit 101 at the second fluid conduit connection 107.

The second coupling housing 100 further comprises a second axial end located opposite the first axial end. The second axial end is configured with a coupling flange 105 extending radially from the coupling housing 100 at the second axial end and is suitable for coupling to the coupling flange 205 for providing a sealing coupling. The second coupling flange 105 displays an opening 112 for flow of fluid therethrough. The second coupling housing 100 may comprise a coupling gripper interface 103 arranged at a side of the second coupling housing 100 and a coupling gripper actuator 106 for activating the coupling gripper 103 for gripping the coupling gripper interface 207.

The second coupling housing 100 comprises a central longitudinal axis A_x running centrally through the second coupling housing 100 in the axial direction from the second axial end to the first axial end and defining an axial direction z , a radial direction r and a circumferential direction c of the second coupling housing 100.

The second coupling housing 100 comprises a second valve assembly 120 with a second valve disc 124 that is configured for sealingly closing the opening 112 by sealingly interacting with a second valve seat 108. The second valve disc 124 comprises a second valve disc surface 124a facing the opposite direction of the axial direction z . The second valve assembly 120 is connected to the second coupling housing 100 via a second valve assembly support 109.

The second valve disc 124 may be connected to a second valve rod 121 which in turn may be configured with a valve actuator 125 that comprises a hydraulic inlet 122 and a hydraulic outlet 123. The valve actuator is suitable for driving the second valve rod 121 and the second valve disc 124 in the along the central longitudinal axis A_x by operating the hydraulic inlet 122 and hydraulic outlet 123. The valve actuator 125 may be integrated in the second valve assembly support 109. The hydraulic inlet 122 and hydraulic outlet 123 may be connected to sources for pressurized hydraulic fluid and the valve actuator 125 may be operated by controlling flow of hydraulic fluid through the hydraulic inlet 122 and hydraulic outlet 123.

The second coupling housing 100 may also comprise a guiding pin 104 that extends axially from the second coupling flange 105, preferably from the radial periphery of the coupling flange 105. The guiding pin 104 is suitable for aligning the central longitudinal axis A_x with the central longitudinal axis B_x by contacting the outer periphery of the coupling flange 205 when the coupling housing 200 and the second coupling housing 100 is brought in proximity.

Fig. 9 shows the coupling housing 200 and the second coupling housing 100 in close proximity where the coupling gripper 103 is ready for engaging with the coupling gripper interface 207 and where the second valve disc surface 124a is ready for contacting the push pin 221. The guide pin 104 is in contact with the periphery or outer edge of the coupling flange 205 for aligning the central longitudinal axis A_x with central longitudinal axis B_x .

Fig. 10 shows that the second valve disc surface 124a has made contact with and pushed the push pin 221 axially into the valve disc 224, ie pushed the push pin from the first position to the second position and thereby switching the locking mechanism 250 from the locked position to the unlocked position. The coupling gripper actuator 106 may be activated such that a sufficient force for pushing the push pin 221 from the first to the second position via the coupling gripper 103 that interacts with the coupling gripper interface 207 for pulling the coupling housing 200 and the second coupling housing 100 together. Said force is also sufficient for achieving a sealing pressure between the coupling housing 200 and the second coupling housing 100.

Now turning to Fig. 11 which illustrates that the valve actuator 125 has been activated to axially move the second valve disc 124 towards the coupling housing 200. The second valve disc surface 124a has contacted the valve disc surface 224a and then pushed the valve disc 224 into the coupling housing, thereby switching the valve assembly 220 and the second valve assembly 120 from the respective closed positions shown in Fig. 10 to the respective open positions shown in Fig. 11. Fig. 11 thus shows a coupling where flow of a fluid, such as gas and liquid, in both directions through the coupling is possible.

With reference to Fig. 8, 9, 10 and 11 the steps to ensure a successful coupling of two fluid conduits may proceed as follows:

- Providing a coupling housing 200 and a second coupling housing 100 as disclosed above.
- Moving the coupling housing 200 second coupling housing 100 within proximity of each other, such as within about 1 meter, 0.5m, 0.2m, 0.1m or 0.05m.
- Aligning the central longitudinal axis A_{Ax} with the central longitudinal axis B_{Bx} , by maneuvering one or both of the coupling housing 200 and the second coupling housing 100.
- Moving either one or both of the coupling housing 200 and the second coupling housing 100 for achieving contact between the second valve disc surface 124a and the push pin 221.
- Moving the coupling housing 200 axially towards the second valve disc 124 for pushing the push pin 221 from the first position to the second position and thereby switching the locking mechanism 250 from the locked position to the unlocked position. The skilled person would understand that this step could also or alternatively comprise moving the second valve disc 124 towards the coupling housing 200 for pushing the push pin 221
- Moving the second valve disc 124 axially towards the coupling housing 200 in order to push the second valve disc 124 and the valve disc into the coupling housing 200 and thereby switching the valve assembly 220 and second valve assembly 120 from the closed position to the open position and establishing a fluid connection between the fluid conduits 101, 201.

The following steps may also be executed:

- Aligning the central longitudinal axis A (A_x) with the central longitudinal axis B (B_x), by allowing the at least one guide pin 104 to contact the coupling flange 205.

And:

- When the coupling housing 200 and the second coupling housing 100 is in proximity, activating the coupling gripper 103 for engaging the coupling gripper interface 207 such that the second coupling housing 100 and the first coupling housing 200 are pulled together with a force sufficient to create a sealing pressure between the second coupling flange 105 and the coupling flange 205.

The skilled person understands that the coupling is releasable such that the steps may be done in reverse in order to close the valve assembly 220 and the second valve assembly 120 and release the coupling with minimal or no risk of spilling of fluid.

It is appreciated that certain features of the invention, which, for clarity, have been described above in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which, for brevity, have been described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination.

List of references:

10	Coupling system
100	Second coupling housing
101	Second fluid conduit
103	Coupling gripper
104	Guide pin
105	Second coupling flange
106	Coupling gripper actuator
107	Second fluid conduit connection
108	Second valve seat
109	Second valve assembly support
112	Opening
A _x	Axis A
120	Second valve assembly
121	Second valve rod
122	Hydraulic inlet
123	Hydraulic outlet
124	Second valve disc
124a	Second valve disc surface
125	Valve actuator
200	Coupling housing
201	Fluid conduit

202	Fluid conduit connection (Swivel connection)
203	First axial end
204	Second axial end
205	Coupling flange
206	Coupling housing valve seat
207	Coupling gripper interface
209	Valve assembly support
211	Rotation stopper
212	Opening
213	Coupling housing groove
220	Valve assembly
221	Push pin
223	Valve disc sealing
224	Valve disc
224a	Valve disc surface
226	Valve force means
227	Valve rod
231	Push pin rotation stopper
233	Valve assembly casing
233a	Valve assembly casing top edge
234	Valve force means bracket
235	Valve rod force means bracket
240	Valve assembly housing
241	Valve assembly housing slots
250	Locking mechanism
251	Locking bar
252	Rotational ring
253	Rotation activator
254	Rotation activator teeth
α	Rotation activator teeth angle
255	Rotational ring recess
256	Secondary force means
A _x	Axis A
B _x	Axis B
C _x	Axis C

CLAIMS

1.

A coupling housing (200) suitable for sealingly coupling fluid conduits wherein the coupling housing (200) is configured in a first axial end (203) for fluid connection to a fluid conduit (201), the coupling housing (200) comprising

- a second axial end opposite of the first axial end,
- a central longitudinal axis B (B_x), defining an axial direction (z) from the first axial end to the second axial end, a radial direction (r) and a circumferential direction (c),
- a coupling flange (205) extending in the radial direction (r) and arranged at the second axial end, the coupling flange (205) comprising an opening (212) for flow of fluid therethrough,
- a valve assembly (220) comprising
 - a valve disc (224) configured to be axially movable relative to the coupling housing (200) and comprising a valve disc surface (224a) facing substantially in the same direction as the coupler flange (205),

wherein the valve assembly (220) is connected to the coupling housing (200) and configured to switch between

- a closed position, wherein the valve disc (224) is configured to sealably cover the opening (212), and
- an open position wherein the valve disc (224) is removed from the opening (212) for allowing flow of fluid therethrough,

characterized in that

the valve assembly (220) further comprises

- a push pin (221) arranged for protruding through the valve disc surface (224a), wherein the push pin (221) is configured to be axially movable relative to the valve disc (224),
- a locking mechanism (250) connected to and activated by the push pin (221),

wherein the locking mechanism (250) is configured to switch between

- a locked position for locking the valve assembly (220) in the closed position, wherein the push pin (221) in a first position protrudes through the valve disc surface (224a) and
- an unlocked position, wherein the push pin (221) in a second position have been moved axially towards the valve disc (224) for allowing the valve assembly (220) to switch to the open position.

2.

The coupling housing (200) according to claim 1, wherein the locking mechanism (250) comprises

- at least one locking bar (251), arranged for connection to the push pin (221),

wherein the at least one locking bar (251) is configured for engaging with the coupling housing (200) when the locking mechanism (250) is in the locked position, and wherein the at least one locking bar (251) is configured for being retracted from the coupling housing (200) when the locking mechanism (250) is in the unlocked position.

3.

The coupling housing (200) according to claim 2, wherein the coupling housing (200) comprises

- a coupling housing groove (213) arranged internally in the coupling housing (200) and extending at least a part of the circumferential extent of the coupling housing (200),

wherein the at least one locking bar (251) is configured for extending into the coupling housing groove (213) when the locking mechanism is in the locked position, and wherein the at least one locking bar (251) is configured for being retracted from the second coupling housing groove (213) when the locking mechanism is in the unlocked position.

4.

The coupling housing (200) according to claim 3, wherein the locking mechanism (250) comprises

- a rotation activator (253) comprising at least one rotation activator tooth (254), fixed proximal to a first axial end of the push pin (221),
- a rotational ring (252) arranged coaxially and rotatably around the push pin (221), the rotational ring (252) comprising at least one rotational ring recess (255) adapted for receiving the at least one rotation activator tooth (254),
- a central longitudinal axis C (C_x), defining an axial direction (z) from the axial end distal from the first end of the push pin (221) to the first end of the push pin (221), a radial direction (r) and a circumferential direction (c),

wherein the at least one locking bar (251) is connected radially to the rotational ring (252), wherein the at least one rotation activator tooth (254) is arranged at an angle (α) that is inclined compared to the central longitudinal axis C (C_x) and configured to interact with the at least one rotational ring recess (255) when the push pin (221) is moved in an axial direction for initiating radial movement of the at least one locking bar (251).

5.

The coupling housing (200) according to claim 3 or 4 wherein the valve assembly (220) further comprises

- a valve assembly housing (240) for accommodating the valve disc (224) and the locking mechanism (250) therein,

wherein the valve assembly housing (240) comprises valve assembly housing slots (241) and the at least one locking bar (251) is aligned with the valve assembly housing slots (241).

5 6.
The coupling housing (200) according to claim 5, wherein the valve assembly (220) comprises

- a valve assembly casing (233) for slidably accepting at least a part of the valve assembly housing (240) therein.

10

7.
The coupling housing (200) according to claim 6, wherein the valve assembly casing (233) comprises

- a top edge (233a) facing in the axial direction (z) configured for abutting against the side of the valve disc (224) facing opposite of the axial direction (z) for limiting the axial travel of the valve disc (224).

8.
The coupling housing (200) according to claim 6 or 7, wherein the coupling housing (200) comprises

- a push pin rotation stopper (231) fixed to the push pin (221), and
- a rotation stopper (211) fixed to the valve assembly casing (233)

wherein the push pin rotation lock (231) protrudes radially from the push pin (221), extends in the axial direction and is arranged for interaction the rotation stopper (211) for limiting the rotation of the push pin (221) in the circumferential direction.

25 9.
The coupling housing (200) according to any of the preceding claims, wherein the valve assembly (220) comprises

- a force means (226) connected to the coupling housing (200) and configured for biasing the valve assembly (220) towards the closed position.

30 10.

The coupling housing (200) according to any of the preceding claims, wherein the locking mechanism comprises a secondary force means (256) for biasing the push pin (221) towards the first position.

11.
35 The coupling housing (200) according to any of the preceding claims, wherein the coupling housing (200) comprises

- a valve assembly support (209) fixed to the coupling housing (200), and
wherein the valve assembly (220) is fixed to the valve assembly support (209).

12.

A coupling system (10) for sealingly coupling fluid conduits comprising

- 5 - a coupling housing 200 according any of the claims 1-11,
and
 - a second coupling housing (100) configured at a first axial end for fluid
 connection to a second fluid conduit (101), the second coupling housing (100)
 comprising
10 - a second axial end opposite of the first axial end,
 - a central longitudinal axis A (A_x), defining an axial direction (z) from the
 second axial end to the first axial end, a radial direction (r) and a
 circumferential direction (c),
15 - a second coupling flange (105) extending in the radial direction (r) and
 arranged at the second axial end, the second coupling flange (105)
 comprising an opening (112) for flow of fluid therethrough,
 - a second valve assembly (120) comprising
 - a second valve disc (124) configured to be axially movable relative
20 to the second coupling housing (100) and comprising a second
 valve disc surface (124a) facing substantially in the same direction
 as the second coupling flange (105),

wherein the second valve assembly (120) is connected to the second coupling
housing (100) and configured to switch between

- 25 - a closed position wherein the second valve disc (124) is configured to
 sealably cover the second opening (112) and
 - an open position, wherein the second valve disc (124) has been removed
 from the second opening (112) for allowing flow of fluid therethrough,

wherein the second valve disc surface (124a) is configured for contacting and
moving the push pin (221) from the first position to the second position, and

- 30 wherein the second valve disc surface (124a) is further configured for contacting the
 valve disc surface (224a) and for moving axially into the coupling housing (200)
 and thereby switching the second valve assembly (120) and the coupling house
 assembly (220) between the respective closed and the open positions for allowing
 fluid to flow therethrough.

35

13.

- The coupling system (10) according to claim 12, wherein the second coupling
housing (100) comprises at least one guide pin (104) extending axially from the
second coupling flange (105) configured for contacting coupling flange (205) for
40 aligning the central longitudinal axis A (A_x) with central longitudinal axis B (B_x).

14.
The coupling system (10) according to claim 12 or 13, wherein the second valve assembly (120) comprises a valve actuator (125) configured for moving the second valve disc (124) axially.
- 5 15.
The coupling system (10) according to claim 14, wherein the valve actuator (125) comprises
- a hydraulic inlet (122), and
 - a hydraulic outlet (123).
- 10 16.
The coupling system (10) according to claim 15, wherein the hydraulic inlet (122), and the hydraulic outlet (123) is integrated in a second valve assembly support (109).
- 15 17.
The coupling system (10) according to any of the claims 12-16, wherein the coupling housing (200) comprises
- a coupling gripper interface (207), and
- the second coupling housing (100) comprises
- 20 - a coupling gripper (103) configured for engaging with the coupling gripper interface.
18.
The coupling system (10) according to any of the claims 12-17, wherein the second coupling housing (100) comprises
- 25 - a second valve assembly support (109) fixed to the second coupling housing (100), and
- wherein the second valve assembly (120) is fixed to the valve assembly support (109).
19.
30 A method for sealingly coupling fluid conduits, the method comprising the steps of
- providing the coupling system (10) according to claim 12,
 - moving the coupling housing (200) and the second coupling housing (100) in proximity of each other,
 - aligning the central longitudinal axis A (A_x) with the central longitudinal axis B (B_x),
- 35

- achieving contact between the second valve disc surface (124a) and the push pin (221)
- axially moving the coupling housing (200) towards the second valve disc (124) for pushing the push pin (221) from the first position to the second position and thereby switching the locking mechanism (250) from the locked position to the unlocked position, and achieving contact between the second valve disc surface (124a) and the valve disc surface (224a),
- axially moving the second valve disc (124) towards the coupling housing (200) for pushing the second valve disc (124) and the valve disc (224) into the coupling housing (200) and thereby switching the valve assembly (220) and second valve assembly (120) from the closed position to the open position and establishing a fluid connection between the fluid conduits (101, 201).

20.

The method according to claim 19, wherein the method further comprises the following

- in step A, providing the coupling system (10) according to claim 13,
- in step C, aligning the central longitudinal axis A (A_x) with the central longitudinal axis B (B_x), by allowing the at least one guide pin (104) to contact the coupling flange (205).

20

21.

The method according to claim 19 or 20, wherein the method further comprises the following

- in step A further providing the coupling system (10) according to claim 17,
- in step D coupling the second coupling housing (100) and the first coupling housing (200) by activating the coupling gripper (103) for engaging the coupling gripper interface (207) such that the second coupling housing (100) and the first coupling housing (200) are pulled together with a force sufficient to create a sealing pressure between the second coupling flange (105) and the coupling flange (205).

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